WHAT IS CLAIMED IS:

1. A method for separating mono-olefins comprising:
   a) contacting a mixture comprising di-olefins and mono-olefins with an olefin-complexing metal salt dissolved, dispersed, or suspended in an ionic liquid;
   b) maintaining such mixture in contact with such olefin-complexing metal salt for sufficient time to selectively complex the di-olefins over the mono-olefins to form a metal salt/olefin complex; and
   c) separating the non-complexed mono-olefins.

2. The method of claim 1, further comprising desorbing the di-olefins from the metal salt/olefin complex.

3. The method of claim 2, wherein said ionic liquid is capable of forming a solution, suspension or dispersion with said olefin-complexing metal salt.

4. The method of claim 3, wherein the amount of said olefin-complexing metal salt is adjusted so as to complex essentially only the di-olefins.

5. The method of claim 1, wherein the metal salt comprises a Group IB metal.

6. The method of claim 5, wherein the metal salt is a copper salt.

7. The method of claim 6, wherein the metal salt is CuOTf.

8. The method of claim 5, wherein the metal salt is a silver salt.

9. The method of claim 8, wherein the metal salt is $AgBF_4$.

10. The method of claim 1, wherein the mono-olefin and di-olefin-

containing mixture is a gaseous olefin-containing stream.

11. The method of claim 1, wherein said mixture is contacted with said olefin-complexing metal salt in a distillation apparatus.

12. The method of claim 11, further comprising separating said non-complexed mono-olefins by distillation in said distillation apparatus.

13. The method of claim 12, further comprising desorbing said di-olefins from said metal salt/olefin complex by distillation in said distillation apparatus.

14. The method of claim 1, wherein said mixture is contacted with said olefin-complexing metal salt in a system of one or more liquid mixers.

15. The method of claim 14, further comprising separating said non-complexed mono-olefins from said metal salt/olefin complex by decantation.

16. The method of claim 15, further comprising desorbing said di-olefins from said metal salt/olefin complex in a regeneration apparatus.

17. The method of claim 16, further comprising sending the bottoms from said regeneration apparatus to said system of liquid mixers.

18. The method of claim 1, wherein the mixture of mono- and di-olefins is derived from wax hydrocracking, paraffin dehydrogenation, or combinations thereof.

19. The method of claim 1, further comprising subjecting the mixture to partial hydrogenation prior to the contacting step.

20. A method for separating mono-olefins comprising:

a) contacting a mixture comprising di-olefins and mono-olefins with an olefin-complexing metal salt dissolved, dispersed, or suspended in an ionic liquid;
b) maintaining such mixture in contact with such olefin-complexing metal salt for sufficient time to complex the mono-olefins and di-olefins with the olefin-complexing metal salt to form a metal salt/olefin complex; and
c) selectively desorbing the mono-olefins from the metal salt/olefin complex.

21. The method of claim 20, further comprising desorbing the di-olefins from the metal salt/olefin complex.

22. A method for separating mono-olefins and/or di-olefins comprising:
a) contacting a mixture comprising di-olefins, mono-olefins and non-olefins with an olefin-complexing metal salt dissolved, dispersed or suspended in an ionic liquid;
b) maintaining such mixture in contact with such olefin-complexing metal salt for sufficient time to complex the mono-olefins and di-olefins with the olefin-complexing metal salt to form a metal salt/olefin complex;
c) separating the non-complexed non-olefins; and
d) selectively desorbing the mono-olefins from the metal salt/olefin complex.

23. The method of claim 22, further comprising desorbing the di-olefins from the metal salt/olefin complex.

24. The method of claim 23, wherein said ionic liquid is capable of forming a solution, suspension or dispersion with said olefin-complexing metal salt.

25. The method of claim 22, wherein the metal salt comprises a Group IB

metal.

26. The method of claim 25, wherein the metal salt is a copper salt.

27. The method of claim 26, wherein the metal salt is CuOTf.

28. The method of claim 25, wherein the metal salt is a silver salt.

29. The method of claim 28, wherein the metal salt is $AgBF_4$.

30. The method of claim 22, wherein the non-olefins comprise at least one of paraffins, oxygenates, aromatics, or mixtures and combinations thereof.

31. The method of claim 30, wherein the paraffins comprise cycloparaffins.

32. The method of claim 22, wherein the mono-olefins comprise at least one of ethylene, propylene, or mixtures and combinations thereof.

33. The method of claim 32, wherein the ethylene is produced in an ethylene cracker, an EP cracker, a naphtha cracker, or combinations thereof.

34. The method of claim 22, wherein the olefins are produced in an apparatus selected from the group consisting of an FCC unit, naphtha hydrotreater, catalytic reformer, distillate hydrotreter, hydrocracker, coker, RFCC unit, RDS unit and combinations thereof.

35. The method of claim 22, wherein the olefins are derived from paraffin dehydrogenation, ethylene oligomerization, wax hydrocracking, or combinations thereof.

36. The method of claim 22, wherein the olefins are produced in a Fischer-

Tropsch synthesis.

37. The method of claim 22, wherein the mono-olefins are normal alpha olefins derived from the ethenolysis of heavier internal olefins.

38. The method of claim 22, wherein the olefins are separated from a recycle stream in a Fischer-Tropsch synthesis to reduce the amount of olefins recycled from a Fischer-Tropsch unit to an upstream methane reformer.

39. The method of claim 22, wherein the olefin-containing mixture is a gaseous olefin-containing stream.

40. The method of claim 22, wherein said mixture is contacted with said olefin-complexing metal salt in a distillation apparatus.

41. The method of claim 40, further comprising separating said non-complexed non-olefins from said metal salt/olefin complex by distillation.

42. The method of claim 41, further comprising desorbing said mono-olefins from said metal salt/olefin complex by distillation in said distillation apparatus.

43. The method of claim 42, further comprising desorbing said di-olefins from said metal salt/olefin complex by distillation in said distillation apparatus.

44. The method of claim 22, wherein said mixture is contacted with said olefin-complexing metal salt in a system of one or more liquid mixers.

45. The method of claim 44, further comprising separating said non-complexed non-olefins from said metal salt/olefin complex by

decantation.

46. The method of claim 45, further comprising desorbing said mono-olefins from said metal salt/olefin complex in a regeneration apparatus.

47. The method of claim 46, further comprising desorbing said di-olefins from said metal salt/olefin complex in said regeneration apparatus.

48. The method of claim 47, further comprising sending the bottoms from said regeneration apparatus to said system of liquid mixers.

49. The method of claim 22, further comprising purifying the olefin-containing mixture before the contacting step to remove sulfur, acetylinics, oxygenates, and other heteroatoms.

50. A method for separating mono-olefins and/or di-olefins comprising:

a) contacting a mixture comprising di-olefins, mono-olefins and non-olefins with an olefin-complexing metal salt dissolved, dispersed or suspended in an ionic liquid;

b) maintaining such mixture in contact with such olefin-complexing metal salt for sufficient time to selectively complex the di-olefins over the mono-olefins to form a first metal salt/olefin complex;

c) separating the non-complexed mono-olefins and non-olefins;

d) desorbing the di-olefins from the first metal salt/olefin complex;

e) contacting the non-complexed mono-olefins and non-olefins with the olefin-complexing metal salt;

f) maintaining such non-complexed mono-olefins and non-olefins in contact with such olefin-complexing metal salt for sufficient time to complex the mono-olefins to form a second metal salt/olefin complex; and

g) separartating the non-complexed non-olefins.

51. The method of claim 50 further comprising desorbing the mono-olefins

from the second metal salt/olefin complex.

52. The method of claim 51, wherein the amount of said olefin-complexing metal salt is adjusted so as to complex essentially only the di-olefins.

53. The method of claim 1, wherein said ionic liquid is comprised of anions and cations, wherein;
said anions are selected from the group consisting of halide salts, metal anions, chloroaluminate, bromoaluminate, gallium chloride, tetrafluoroborate, tetrachloroborate, hexafluorophosphate, nitrate, trifluoromethane sulfonate, methylsulfonate, *p*-toluenesulfonate, hexafluoroantimonate, hexafluoroarsenate, tetrachloroaluminate, tetrabromoaluminate, perchlorate, hydroxide anion, copper dichloride anion, iron trichloride anion, antimony hexafluoride, copper dichloride anion, zinc trichloride anion, lanthanum anion, potassium anion, lithium anion, nickel anion, cobalt anion, manganese anion, and combinations and mixtures thereof; and
said cations are selected from the group consisting of cyclic and non-cyclic quaternary ammonium cations, alkylammoniums, pyridiniums, substituted pyridiniums, N-alkylpyridiniums, imidazoliums, substituted imidazoliums, N,N'-dialkylimidazoliums, pyrroliniums, substituted pyrroliniums, phosphoniums, alkylphosphoniums, arylphosphoniums, 1-butyl-3-methylimidazolium, N-hexylpyridinium, 1-hexyl-3-methylimidizolium, $(C_8H_{17})_3MeN$, Bu_2Me_2N, and mixtures and combinations thereof.

54. The method of claim 22, wherein said ionic liquid is comprised of anions and cations, wherein;
said anions are selected from the group consisting of halide salts, metal anions, chloroaluminate, bromoaluminate, gallium chloride, tetrafluoroborate, tetrachloroborate, hexafluorophosphate, nitrate, trifluoromethane sulfonate, methylsulfonate, *p*-toluenesulfonate, hexafluoroantimonate, hexafluoroarsenate, tetrachloroaluminate,

tetrabromoaluminate, perchlorate, hydroxide anion, copper dichloride anion, iron trichloride anion, antimony hexafluoride, copper dichloride anion, zinc trichloride anion, lanthanum anion, potassium anion, lithium anion, nickel anion, cobalt anion, manganese anion, and combinations and mixtures thereof; and

said cations are selected from the group consisting of cyclic and non-cyclic quaternary ammonium cations, alkylammoniums, pyridiniums, substituted pyridiniums, N-alkylpyridiniums, imidazoliums, substituted imidazoliums, N,N'-dialkylimidazoliums, pyrroliniums, substituted pyrroliniums, phosphoniums, alkylphosphoniums, arylphosphoniums, 1-butyl-3-methylimidazolium, N-hexylpyridinium, 1-hexyl-3-methylimidizolium, $(C_8H_{17})_3MeN$, Bu_2Me_2N, and mixtures and combinations thereof.

55. A method for optimizing the method of claim 1, comprising preparing a combinatorial library including a plurality of combinations of ionic liquids and olefin-complexing metal salts, and evaluating the library for its ability to separate di-olefins from a mixture comprising mono-olefins and di-olefins.

56. A method for optimizing the method of claim 22, comprising preparing a combinatorial library including a plurality of combinations of ionic liquids and olefin-complexing metal salts, and evaluating the library for its ability to separate olefins from a mixture comprising olefins and non-olefins.